Sustained and Coordinated Processing of Environmental Satellite data for Climate Monitoring

Project Proposal SCOPE-CM Phase 2

1. Project title

Inter-calibration of imager **o**bservations from time-series of **geo**stationary satellites (IOGEO)

2. Main applicant

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3. Composition of the project team for this project

EUMETSAT (Darmstadt, Germany)	R. Roebeling, T. Hewison, A. Lattanzio, V. John, F. Ruethrich
EUMETSAT CM SAF, Deutscher Wetterdienst (DWD)	Marc Schröder
JMA (Tokyo, Japan)	Masaya Takahashi
NOAA's NCDC (Asheville, NC, US)	Kenneth Knapp, Anand Inamdar
CMA NSMC (Beijing, China)	Peng Zhang, Xiuqing Hu
IMD (Delhi, India)	Ashim Mitra
KMA (Seoul, Korea)	Dohyeong Kim, Hyesook Lee
ISRO	tbc

4. Satellite Climate Data Records capabilities

a. Objectives and proposed product

The major objective of this SCOPE-CM project is the generation of a Fundamental Climate Data Record (FCDR) of calibrated and quality-controlled geostationary sensor data. The FCDR will contain the visible, IR window and water vapour absorption channels of geostationary satellites. It is proposed to utilise the inter-satellite methodology developed by GSICS to tie existing time series of satellite data to the best reference available in space. For the thermal infrared spectral range data from the Infrared Atmospheric Sounder Interferometer (IASI), the Atmospheric Infrared Sounder (AIRS) and the High Resolution Infrared Sounder (HIRS) will be used to reference and to link the geostationary IR observations in a traceable approach. In the visible spectral range several techniques developed by GSICS will be tested on their value for the creation of a CDR. The resulting FCDR will be designed to allow the generation of homogeneous geophysical products, either through direct retrieval or data assimilation into reanalysis, that are accurate and stable enough for climate monitoring. The output of this project can be of immediate use for other SCOPE-CM projects, such as those on surface albedo derived from geostationary satellites. The proposed project also offers a feedback mechanism to the applicability of GSICS methodologies for the creation of CDRs.

b. Satellite sensor record

The time series cover, depending on the geostationary satellite concerned, a period of about 30 years, which is roughly the period 1982 – date. The coverage of the water vapour channel is shorter and basically starts in the mid 1990s, with the exception of Meteosat that starts in 1982. The generation of the FCDRs is currently restricted to the visible, infrared and water vapour channels that the geostationary satellites operated by the participating space agencies shared over the entire time-series. The level-1 records of digital counts are archived at the six space agencies participating in this activity, i.e., The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the Japan Meteorological Agency (JMA), the National Oceanic and Atmospheric Administration (NOAA), the Chinese Meteorological Administration (CMA), the Indian Meteorological Department (IMD), and the Korea Meteorological Administration (KMA). The satellites operated by these space agencies are: the Meteosat satellites from EUMETSAT, the Geostationary Meteorological Satellites (GMS) and Multi-Functional Transport Satellite (MTSAT) from JMA, the Geostationary Orbiting Environmental Satellites (GOES) from NOAA, the Fengyun-2 Geostationary Meteorological Satellites (FY-2) from CMA, the Indian National SATellites (INSATs) and Kalpana satellites from IMD, and the Communication, Ocean and Meteorological Satellite (COMS) from KMA. The generation of the FCDRs derived from level-1 digital counts and/or radiances is the responsibility of each participating space agency. These agencies will perform their processing employing an agreed recalibration approach, and apply it to level-1 native resolution observations of their respective instruments. It is planned to contact further agencies operating geostationary satellites to join this project. Candidates SCOPE-CM member is NASA. The mail applicant of this SCOPE-CM project will establish contacts with these agencies, inform them about the project objectives, and invite them to contribute to the project.

5. Justification of the proposed project

a. Historical overview of related activities

The work proposed in this SCOPE-CM project largely relies on the calibration strategies developed within GSICS. GSICS is an international collaborative effort initiated in 2005 by WMO and the CGMS, that has committed to monitor, improve and harmonize the quality of observations from operational weather and environmental satellites of the Global Observing System (GOS). GSICS aims at ensuring consistent accuracy among space-based observations worldwide for climate monitoring, weather forecasting, and environmental applications. This is achieved through a comprehensive calibration strategy which involves: i) monitoring instrument performances, ii) operational inter-calibration of satellite instruments, iii) tying the measurements to absolute references and standards, and iv) recalibration of archived data[1].

The scientific literature describes several studies on the recalibration of infrared and water vapour channels. Picon et al. (2003)[2] anchored the Meteosat-5 water vapour channel to the NOAA-12 HIRS channel 12 and then used ERA-40 reanalysis data to correct biases of the entire series of METEOSAT satellites with respect to the anchor point. Brogniez et al. (2009)[3] were utilising the data set for successfully studying inter-annual variability of upper

[1] Goldberg M., G. Ohring, J. Butler, C. Cao, R. Datla, D. Doelling, V. Gartner, T. Hewison, B. Iacovazzi, D. Kim, T. Kurino, J. Lafeuille, P. Minnis, D. Renaut, J. Schmetz, D. Tobin, L. Wang, F. Weng, X. Wu, F. Yu, P. Zhang and T. Zhu., 2011: The Global Space-based Inter-Calibration System (GSICS), Bulletin of the American Meteorology Society, 92, 467475, DOI:10.1175/2010BAMS2967.1.

[2] Picon, L., R. Roca, S. Serrar, J. L. Monge, and M. Desbois, 2003, A new METEOSAT ‘‘water vapor’’ archive for climate studies, J. Geophys. Res., 108(D10), 4301, doi:10.1029/2002JD002640.

[3] Brogniez H., Roca R. and L. Picon 2009 A study of the free tropospheric humidity interannual variability using Meteosat data and an advection-condensation transport model J. Climate 22, 6773-6787.

tropospheric humidity. Knapp et al. (2012)[4] used HIRS observations as recalibration reference for an improved ISCCP B1 radiance product by first deriving a homogenised HIRS record that is then applied to correct the geostationary satellites. Contrary to Brogniez et al. (2009), Knapp et al. (2012) performed an inter-satellite calibration, i.e., they applied their recalibration approach to different geostationary satellites to obtain a FCDR over the area covered by the ring of geostationary satellites. The latter inter-calibration approach can serve as starting point for this SCOPE-CM activity.

Several methods have been developed for the calibration of the visible channels on board passive imaging satellites, such as methods using well understood targets (e.g. deserts, moon, and deep convective clouds) and methods using simultaneous nadir overpasses with other passive images[5] or spectrometer observations like SCIAMACHY[6]. Till date, the methods presented in these papers have only been applied as recalibration method for observations from a single instrument operated on a series of satellites, and never been applied in an inter-calibration setting. This will be the challenge of this SCOPE-CM activity.

b. Summary of proposed project

Recalibration approaches will be exchanged between the six project partners. The applied approaches will be based on the methods assessed within the international collaborative effort "Global Space-based Inter-Calibration System" (GSICS), as well as from previous recalibration studies. The calibration accuracy and precision will be evaluated by comparing re-calibrated radiances of the different geostationary satellites in overlap regions. The initial aim of this SCOPE-CM activity is to provide FCDRs of re-calibrated radiances for each participating geostationary satellite at the native instrument resolution. The final aim is to provide a re-gridded (0.05x0.05 degrees) combined global (-70 to 70 degrees) data record (1982-date) at hourly resolution of inter-calibrated radiances including all participating geostationary satellites. Note that an hourly frequency is not feasible at all locations because some geostationary satellites provided data at lower resolution at the beginning of the time-series.

For the inter-calibration of the radiances from the infrared and water vapour channels the approach developed by NOAA serves as baseline (Knapp et al., 2012). Within GSICS further work has been done to minimize the spectral conversion uncertainties between the reference observations from HIRS and the infrared and water vapour observations from the geostationary satellites (Hewison, 2013; Hu et al. 2013; Kim et al. 2015)[7,8,9]. Moreover, observations from the IASI instrument have already been used to monitor quality and stability of the HIRS observations on Metop-A. Thus, the IASI instrument can be employed as reference observation. This project will develop a novel inter-calibration approach using

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[4] Knapp Kenneth R., 2012: Intersatellite bias of the high-resolution infrared radiation sounder water vapor channel determined using ISCCP B1 data, Journal of Applied Remote Sensing. 6(1), doi: 10.1117/1.JRS.6.063523.

[5] Ham, S.-H., and B.J. Sohn, 2010: Assessment of the calibration performance of satellite visible channels using cloud targets: Application to Meteosat-8/9 and MTSAT-1R, Atmos. Chem. Phys., 10, 1-19.

[6] Doelling, D.R., C. Lukashin, P. Minnis, B. Scarino, D. Morstad, 2012: Spectral reflectance corrections for satellite intercalibrations using SCIAMACHY data *Geoscience and Remote Sensing Letters*, **1**, 119-123.

[7] Hewison, T. J., 2013: An Evaluation of the Uncertainty of the GSICS SEVIRI-IASI Inter-Calibration Products", IEEE Trans. Geosci. Remote Sens., vol. 51, no. 3, Mar. 2013, doi:10.1109/TGRS.2012.2236330

[8] Hu, X., Xu, N., Weng, F., Zhang, Y., Chen, L., Zhang, P., 2013: Long term Monitoring and Correction of FY-2 Infrared Channel Calibration Using AIRS and IASI, IEEE Trans. Geosci. Remote Sensing, Vol.11, No.10, 5008-5018, (in press).

[9]Kim, D. et al., 2015: Inter-comparison of the infrared channels of the meteorological imager onboard COMS and hyperspectral IASI data, AAS Vol. 32 No. 7 pp. 979-990: doi: 10.1007/s00376-014-4124-1

double differences between a reference instruments (e.g. IASI) and two monitored instruments (e.g. two GOES satellites) to propagate the calibration back in time. The same approach can be used by replacing the reference instrument with model data (e.g. reanalysis data). Within this SCOPE-CM activity this approach will be further developed and applied to inter-calibrate and validate the level-1 infrared and water vapour radiances of the geostationary imagers of the three space agencies.

Within GSICS an assessment is being made of recalibration and inter-calibration approaches for the visible channels. This SCOPE-CM activity will establish close links with GSICS and take up the recommendations and approaches resulting from this assessment. The selected approach will be adopted and implemented at the space agencies, and applied to inter-calibrate the level-1 visible radiances of their geostationary imagers. Feedback will be provided to GSICS on the performance of the developed approaches.

The major advances that this project makes on top of existing activities are:

- It will make use of best available references in the IR in a consistent way;
- It will use every existing geostationary image and is not restricted to 3 hourly coverage for full Earth scans;
- It will implement novel ways for characterising spectral transfer functions between the instruments extending the classical one-to-one channel clear sky approach;
- It will improve the uncertainty characterisation of the derived FCDR because GSICS methodology involves an assessment of the error budget7, e.g., containing spectral uncertainties, satellite data collocation noise, temporal stability of the chosen reference, etc.;
- It will make use of newly created observation feedback archives from reanalysis centres for validation purposes. This is directly addressing the needs of the major customers of the FCDR data.

The FCDRs will be provided at the native resolution of geostationary instruments observations. In order to assess the inter-satellite consistency a cross-satellite comparison of the FCDRs will be preformed. Once all FCDRs have been generated and evaluated on inter-satellite consistency (2017-2018) the final aim, the assembling of a combined re-gridded FCDR of geostationary satellite radiances will be initiated (next phase 2018-2022).

c. Assessment of the feasibility of the proposed project

The data records of the different geostationary satellites, and of most of the proposed reference instruments, are archived at the three participating space agencies. The GSICS project is already advanced in defining and testing different re-calibration approaches for the visible, infrared and water vapour channels. The participating space agencies are capable to process, archive and distribute the recalibrated datasets.

The involved people are all experienced in the topic of inter-satellite calibration and have leading roles in CDR projects and some are directly involved in GSICS.

The planned improvements to today’s records are scientifically challenging and the project needs a certain funding level that determines the speed of progress.

6. Current and targeted Maturity Level

Besides providing above described FCDRs, the project aims to advance the maturity of these FCDRs.

Table 1: Maturity Matrix FCDRs infrared and water vapor channels

	Software Readiness	Meta Data	Documentation	Validation	Public Access	Utility
Current Maturity level	3.0	3.0	4.0	3.0	3.0	3.0
Targeted Maturity level	5.0	5.0	5.0	4.0	5.0	4.0

Table 2: Maturity Matrix FCDRs visible channels

	Software Readiness	Meta Data	Documentation	Validation	Public Access	Utility
Current Maturity level	0.0	0.0	0.0	0.0	0.0	0.0
Targeted Maturity level	3.0	3.0	4.0	2.0	5.0	3.0

7. Results, challenges and potential contributions of the project

The initial aim of the project is to provide, for the ring of geostationary satellites, FCDRs of visible, infrared and water vapor radiances spanning the entire period of their operations. It is expected that the FCDRs will be utilized in three ways:

- As basis for the derivation of Thematic Climate Data Records (TCDR) such as surface albedo, clear and all sky radiance products, upper tropospheric humidity, cloud properties, surface irradiation, atmospheric motion vectors, etc.;
- As input to global and regional reanalysis;
- As input to advanced climate model validation activities in the framework of Obs4MIPs.

The final aim, the assembling of a combined re-gridded FCDR of all geostationary satellite radiances will be initiated after FCDRs of the individual geostationary satellites have been evaluated on inter-satellite consistency.

Scientific challenges involve the general application of GSICS methodology to past instruments, the quantification of the error budget of inter-satellite calibration process, the validation of the overall quality of the FCDR.

Technical challenges are limited as the participating agencies are experienced in handling all involved data.

8. Duration of the project and tentative schedule

Planned length of project: 5 years; proposed starting date: 1 Jan 2014

9. Expected breakdown of the tasks to be performed in this project;

Task	Year	Actors
− Research the potential of using HIRS on Metop, tied to IASI observations, as reference instrument; − Update the inter-calibration approach for the infrared (IR) and water vapour (WV) channels as used by NOAA, including the useful temporal resolution imagery, double differencing for inter-calibration, and tying the HIRS reference to IASI; − Implement the updated IR & WV inter-calibration approach at the six space agencies; − Recalibration of the IR & WV radiances for the GEO satellites. The deliverable will either be FCDRs of re-calibrated radiances or the recalibration coefficients to create such an FCDR; − Develop a Free Tropospheric Humidity (FTH) geo-ring demonstrator product	2014	EUM, NOAA All space agencies All space agencies All space agencies DWD
− Inter-compare the IR & WV recalibrated radiances in overlapping regions and compare them against output from observational feedback archive at ECMWF;	2015	All space agencies

Task	Year	Actors
– Depending on the outcome of the inter-comparison, adapt the inter-calibration approach, reimplementation it, and repeat the IR & WV recalibration effort; – Prepare and provide user documentation for public distribution of the IR & WV FCDRs or their recalibration coefficients; – Technical assessment of visible (VIS) calibration methods in close collaboration with GSICS, including methods using well understood targets (e.g. DCC, desert, or moon targets) and simultaneous nadir overpass radiance comparisons (e.g. against other imagers or spectrometers); – Regenerate the FTH demonstrator product with the WV FCDRs as input and assess the improvement; – Exchange of collocation and inter-calibration approaches for IR and WV channels; – Establish inter-calibration procedure for IR and WV channels of the Kalpana (and INSAT) satellites series at IMD.		All space agencies All space agencies EUM DWD EUM, IMD EUM, IMD
– Define and select of an inter-calibration approach for the VIS channels; – Implement and test the selected VIS inter-calibration approach at the four agencies; – Find beta users for utilisation of the re-calibrated VIS observations in retrieval applications. – Pilot study on preparing a combined product of inter-calibrated radiances at a common grid. – Recalibration of the IR & WV radiances for Kalpana (and INSAT) satellites series. The deliverable will either be FCDRs of re-calibrated radiances or the recalibration coefficients to create such an FCDR;	2016	All space agencies All space agencies All space agencies All space agencies IMD
– Recalibration of the VIS radiances for the GEO satellites. The deliverable will either be FCDRs of re-calibrated radiances or the recalibration coefficients to create such an FCDR; – Inter-comparison of the VIS recalibrated radiances; – Gather feedback from beta users; – Depending on the outcome of the inter-comparison and feedback process, adapt the inter-calibration approach, re-implementation it; and repeat the VIS recalibration effort; – Exchange of collocation and inter-calibration approaches for VIS channels; – Establish inter-calibration procedure for VIS channels of the Kalpana (and INSAT) satellites series at IMD.	2017	All space agencies All space agencies All space agencies All space agencies EUM, IMD EUM, IMD
– Prepare and provide user documentation for public distribution of the VIS reflected radiance FCDRs or its recalibration coefficients; – Arrange distribution of the FCDRs or recalibration	2018	All space agencies All space agencies

Task	Year	Actors
coefficients from European, Japanese and US sites. – Recalibration of the VIS radiances for Kalpana (and INSAT) satellites series. The deliverable will either be FCDRs of re-calibrated radiances or the recalibration coefficients to create such an FCDR;		IMD

10. Indicate the funding situation

Currently, funding is provided by the participating institutions from their basic funding and as part of EUMETSAT's funding of the CM SAF. Since this funding may not cover all activities proposed outlined in this LoI, delays in the planned schedule are likely. Therefore, the participating institutions may need to seek for additional funding from competitive schemes in Europe, the US, Japan or China to supplement their contributions to this SCOPE-CM activity. The EUMETSAT Central Facility currently has additional funding for the preparation of data records for reanalysis that may be continued for the years 2014-2016.

11. Required and available processing capacities

Required is a distributed processing system capable of producing radiance records output data with a rate of approximately 1 year of data per week limiting the processing time for the 5 geostationary 30 year record to approximately 30 weeks. In addition, means for exchanging the FCDRs for public distribution need to be established.

Currently available and planned processing environments are/will be capable of fulfilling these needs.

12. Curriculum vitae of the key investigators

EUMETSAT:

Dr. Ir. R.A. (Rob) Roebeling: holds a PhD in Environmental Sciences (2008) from Wageningen University, on Cloud Properties Retrievals from Satellite Observations. He has more than 20 years experience in the field of boundary layer meteorology, crop growth modeling, radiative transfer of the cloud atmosphere and multi-sensor remote sensing. From 2000 till 2011 Dr. Roebeling was employed at KNMI as Senior Scientist, where he was leading a research group on cloud physics and head of the three Observations Sections within the Weather Research Division. In 2011, he started working for EUMETSAT as Climate Product Expert, where he leads projects related to the generation of climate data records, and coordinates international efforts to better serve the climate research community with these records. He is co-chair of the International Clouds Working Group (ICWG) within the Coordination Group for Meteorological Satellites (CGMS). He publishes actively, and has served as editor for Meteorology and Atmospheric Physics and as reviewer for several journals.

Dr. Tim Hewison: received the PhD and MSc in Meteorology from University of Reading (UK) in 2006 and 1999, respectively. He is currently the chair of the research working group of the Global Space-based Inter-Calibration System (GSICS), which is an international collaborative effort initiated in 2005 by WMO and the CGMS to monitor and harmonize data quality from operational weather and environmental satellites of the Global Observing System (GOS). Since 2007 he has worked at EUMETSAT, the organization responsible for operating weather satellites for Europe, on the inter-calibration of satellite instruments as part of the GSICS project.

Mr Alessio Lattanzio: has an MSc in Physics and has worked in the field of remote sensing since 1998. He has been involved in albedo retrieval development using geostationary satellite since 2002. He is author and co-author of many papers concerning development and validation of albedo and aerosol retrieval algorithms. Mr Lattanzio is working for SCYSIS, Germany and is currently delegated to EUMETSAT where he is involved in different projects concerning the generation of Climate Data Records (CDRs).

Dr. Viju John: holds a PhD in Natural Sciences (2005) from University of Bremen, Germany on the retrieval and analyses of upper tropospheric humidity from microwave sounders on-board polar-orbiting satellites. He has 15 years of experience in the field of microwave and infrared radiative transfer modelling, remote sensing of atmospheric temperature and water vapour from passive microwave and infrared sensors, and generating fundamental and thematic climate data records using the measurements of the aforesaid satellite sensors. He has also experience in utilising these datasets for evaluating numerical models used for simulating weather and climate. He is currently working in the Climate Services team of EUMETSAT and he is the GSICS representative of the GRUAN working group.

EUMETSAT CM SAF (Deutscher Wetterdienst):

Dr. Marc Schröder: is leading the CM SAF water vapour activities and joined DWD in summer 2007 after a one year visit as visiting scientist at EUMETSAT. He received his PhD from the Free University of Berlin in 2004 and graduated in physics at the University of Oldenburg in 1999. During his studies he visited the University of Wyoming and the University of Wisconsin. He is currently involved in the retrieval of global water vapour and temperature profiles from ATOVS observations, the retrieval of free tropospheric humidity from MVIRI/SEVIRI observations and the retrieval of the Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite data (HOAPS). He is also involved in the development, processing and validation of a SSM/I FCDR. He has published various papers in the fields of satellite and airborne remote sensing as well as radiative transfer. Marc Schröder is co-chairing the GEWEX water vapor assessment, member of the GRUAN task team 5 and PMET.

CMA:

Dr. Peng Zhang: Senior Project Scientist of Chinese meteorolgogical polar orbit satellite Fengyun 3 Series (FY-3) since 2007, Deputy Director-General of National Satellite Meteorological Center (NSMC CMA) since 2013, and GSICS EP vice chair since 2014. He got his Ph.D at IAP/CAS (Institute of Atmospheric Physics, Chinese Academy of Sciences) for atmospheric physics in 1998. From 1998 to 2001, he worked in EORC/NASDA (Earth Observation Research Center, National Space Development Agency of Japan) with Post Doctor position for GLI/ADEOS project. Since 2001, he worked in NSMC/CMA. He is the visiting scholar at CMS/Meteo-France (Centre de Meteorologie Spatiale, Meteo-France) during Sept. 2003 to Dec. 2003. He is the visiting associate scientist at CIMSS/SSEC/UW-Madison (Cooperative Institute for Meteorological Satellite Studies, Space Science and Engineering Center, University of Wisconsin-Madison) during Feb. 2005 to Sept. 2005. He is a member of GSICS (Global Space-based Inter-Calibration System)/WMO and has published various papers in the fields of satellite remote sensing as well as radiative transfer.

Dr. Xiuqing Hu: received the Ph.D. degree in quantitative remote sensing science from the Institute of Remote Sensing Application, Chinese Academy of Sciences, Beijing, in 2012. He is the leader of the calibration/validation group of the Satellite Meteorological Institute of the National Satellite Meteorological Center, China Meteorological Administration, has been a Professor of engineering since 2010, and has been the Instrument Scientist of the Medium Resolution Spectral Imager onboard the Chinese FengYun-3 (FY-3) since 2006. He was a Visiting Scientist in NOAA/NESDIS/STAR from 2011 to 2012. He is currently in charge of the calibration and validation system of FY-3 polar orbiting satellites and FY-4 geostationary satellites. His research interests include calibration and validation for optical and infrared sensors. He is a member of the GSICS Research Working Group and the member of WMO

Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) Regional Steering Group (RSG).

NOAA:

Dr. Ken Knapp: holds a PhD from Colorado State University (2000) in Atmospheric Science. He has published numerous papers on scientific applications of geostationary data and is presently chief of the Products Branch in the Remote Sensing and Applications Division of NOAA's National Climatic Data Center.

Dr. Anand Inamdar: holds a Ph. D. from Indian Institute of Science, Bangalore (India) in 1991. He worked at Scripps Institution of Oceanography, San Diego (1990-2004) as a Co-I on the NASA-CERES project with Prof. V. Ramanathan. He worked on the evolution of the water vapor greenhouse effect, water vapor feedback and is a primary contributor to the operational surface long wave algorithm from CERES. He has later worked for USDA/ARS on the retrieval of LST from MODIS and GOES satellites over the US southwest. Presently he is working on cross-calibration of the ISCCP B1 visible channel using the PATMOS-x data.

JMA:

Mr. Masaya Takahashi: holds a Master of Science (2005) from Kyushu University in geophysics. He is currently the technical officer of System Engineering Division of the Meteorological Satellite Center, the Japan Meteorological Agency. He is GPRC (GSICS Processing and Research Centre) points of contacts for operational matters, and a member of the GSICS Research Working Group.

IMD:

A.K Sharma: Deputy Director General of National Satellite Meteorological Center, IMD since 2007. He holds a Master of Science (1977) from Delhi University in physics. He is currently in charge of the calibration and validation team of INSAT-3D satellite and having 21 years of experience in the field of remote sensing and weather forecast. He is also a member of the GSICS Executive Panel and Research Working Group.

Dr. A.K Mitra: received the Ph.D. degree in quantitative application of remote sensing in weather forecast from the Jadavpur University, in 2014. He is scientist at National Satellite meteorological center, IMD. He is also a member secretary of the calibration and validation team of INSAT-3D satellite. He was the visiting scientist at CIMSS/SSEC/UW-Madison (Cooperative Institute for Meteorological Satellite Studies, Space Science and Engineering Center, University of Wisconsin-Madison) during June. 2010 to October. 2010. He is a member of GSICS (Global Space-based Inter-Calibration System)/WMO and has published various papers in the fields of satellite remote sensing as well as radiative transfer.

KMA:

Dr. Dohyeong Kim: received the Ph.D. degree in Atmospheric Science from Seoul National University in 2003. He is currently Senior Researcher of the Satellite Planning Division of the National Meteorological Satellite Center of Korea Meteorological Administration (KMA/NMSC), a position he has held for the past eight years. He worked for most of his professional career on atmospheric radiation. His primary research areas are the retrieval of radiation budget from surface-based and satellite-based measurements and radiative transfer modeling. He is now in charge of satellite sensor development, i.e. the next generation geostationary and low earth orbit satellites of KMA, and of their sensor calibration.

Dr. Hyesook Lee: received the Ph.D. degree in Astrophysics from Chungnam National University in 2005. She is currently Researching staff of the Satellite Planning Division of the National Meteorological Satellite Center of Korea Meteorological Administration (KMA/NMSC), a position she has held for the past three years. She worked for most of her professional career on the technical management of the development of meteorological/space weather payload and its associated ground segment. She was the research associate at NASA/GSFC-674(Space Weather Lab) from Dec. 2010 to Nov. of 2012. She is now in charge of the project management for the satellite data utilization.